1896: Comptes rendus hebdomadaires des séance de l'Academie des sciences, T. 123, 492-495.
Translated by AltaVista Babel (30 Apr 2007)

A spectrum of cathode rays.

Note of Mr. BIRKELAND.

I described, in the Norwegian Collection Elektroteknisk Tidsskrift (2), some experiments on the cathode rays which show that the cathode, in a discharge tube, emits various groups of rays of different kinds behaving between them in a similar way, with the point of view external, various frequencies emitted by a vibrating cord.

I lately occupied itself to separate one from the other, of a simpler manner, all these groups of cathode rays emitted simultanously by the same cathode, while profiting for that from what they all are differently deviated by magnetic forces.

My discharge tube has a shape as indicated in fig.1, Anode A, formed of an aluminium disc bored of a very narrow slit of 15mm on 0mm, 25, prevents the rays emitted by cathode C to pass in the spherical part of the tube differently than by this slit.

The cathode rays arriving on the spherical bottom of the tube produce there a yellow band of phosphorescence, which is very clear when anode A is put in communication with the ground.

It is necessary to notice here that the appearance of this band changes with the pression in the tube. It can exceed a width of 2mm, even 3mm, if the pressure is relatively considerable, while it is excessively narrow when the pression is very weak.

In this last case and by employing discharges of a rather great tension, I could distinguish two and even often three fine lines, overlapping one almost the other. One obtains a larger spacing of one of these lines with the others, by touching finger the ball of glass, and that preferably with the one of the poles of large Circle ABA; by this process, one of the yellow lines will have deviated towards the side of the finger about of 2mm, while the others remain motionless

To obtain a suitable magnetic deviation of the narrow beam of the rays after their passage by the slit, two small equal electromagnets are laid out as the figure shows it. In the results of measurements which we will further give, the two electromagnets were excited in series by a current always of 2 amps.

When the tube of discharge functions at the same time as the magnets, one usually sees on the spherical wall of the tube a whole spectrum of diffuse lines or yellow bands more or less far away from the primitive yellow line.

To be able to study the influence of the intensity of the current of the décharge on the spectrum, I introduced, in the primary education circuit of the large reel of Ruhmkorff employed, a rheostat allowing to vary the primary education current in a continuous way between 2 and 21 amps.

One observes initially this remarkable fact, that the consecutive bands of the spectrum suddenly appear one after the other when the current primaire believes.

In the following Table, one finds the moment of appearance of the différentes bands in a series of experiments:

[Table: Pression length Bandages Running of the spark of air - - primary parallel in the tube. L 2. 3. 4.]

The first band realized well, even by a current from 2amp, 8 with a length of spark of 5mm. The angles are counted on the sphere of glass starting from the primitive yellow line. The parallel spark is always measured between two balls ' cm in diameter.

Fig. 2 represents, reduces half, the spectrum corresponding to a primary education current of 8amp, 4 and with the pressure of 0mn, 0043. By amplifying the current up to 20 amps, I saw appearing certainly more than ten bands; they however approach too one the other to be well distinguished.

The various bands are probably made of one or more lines moving, In any case, it is sure that the first band consists of an animated line of an oscillatory movement perpendicular to its longuor. By amplifying the primary education current, the oscillations decrease, so that with a current from 7amp, 5, the band became a line of a perfect clearness and a great intensity.

If one makes walk with the hand the switch with mercury employed, one more clearly distinguishes the lines from the various bands and one also sees that they change a little place from one discharge to another. But even with only one discharge, the lines are still oscillating.

When the primary education current increases in a continuous way, the magnetic déviation of all the bands also decreases, and that so as to bring them closer the ones the others.

When the pressure in the tube decreases, the primary education current constant remainder, the magnetic deviation of the cathode rays also decreases in a continuous way, initially quickly, later slowly, like worms a limit.

Without being able to go here into the details, we will state only that, for a primary education current of 6 amps and a pressure from 0nn, 0251, the face of the spectrum was deviated of 96°, while, for a pressure of 0mm, 0001, it was deviated only from 46°, 5.

This dependence of the magnetic deviation of the primary education current and the pressure in the tube could lead to the idea that it depends uniquement on the parallel spark of the tube, i.e. of the tension between the cathode and the anode. That was checked insofar as one can await it when one evaluates the tension in question by the parallel spark of the tube.

If one lays out a micrometer with spark in series with the tube of décharge, one sees leaving the first bandaged of the spectrum of the lines weak, but rather clear, corresponding to cathode rays which are deviated than the others by the magnetic forces.

These lines all the more move away from the principal and motionless part of the spectrum that the length of spark of the micrometer is larger it-' even. The fig. 3 gives, reduces half, the spectrum of discharge of our tube when it was put in series with a micrometer with spark made of two brass balls of 2cm', 7 of diameter, distant of 25mm. The current primaire was of I2 amps and the pressure in the tube of 0mm, 0079.

By employing platinum a cathode, more volatilizable, instead of an aluminium cathode, as I had done before, I tried to examine whether the torn-off metal particles with cathode settle on the bottom of the tube following one of the lines of the spectrum. The result remained up to now undecided ('). "

---

(2) This work appeared almost in extenso in the Files of Geneva, June 1896, dans' Electrical Review, 968 and 969 and clans Zeitschrift to fiir Elektroteknik, XIV and XV.